

Multiplication Theorem

Multiplication principle of counting:

If an event can occur in p different ways, and if ahead it occurs in q different ways, then the total number of different ways of occurrence of the two events is $m \times n$.

If there is a third event which can occur in r different ways after completion the second event then the total number of different ways of occurrence of all the events is $p \times q \times r \dots$

Question 1: Suppose a person can go from Kanpur to Lucknow either by car or by bus or by train or by air. In how many ways can you plan your journey from Kanpur to Lucknow and back to Kanpur.

Solution: A person can go from Kanpur to Lucknow in four different ways, and he can return from Lucknow to Kanpur in four different ways. So, by the multiplication principle of counting, there are $4 \times 4 = 16$ different ways to travel from Kanpur to Lucknow and return to Lucknow to Kanpur

Question 2: Suppose a person can go from Mumbai to Unnao either by car or by train or by air. In how many ways can you plan your journey from Mumbai to Unnao and back to Mumbai.

Solution: A person can go from Mumbai to Unnao in three different ways, and he can return from Unnao to Mumbai in three different ways. So, by the multiplication principle of counting, there are 3×3

= 9 different ways to travel from Lucknow to Jaipur and return to Jaipur from Lucknow.

Question 3: A room has 5 doors . In how many ways can a man enter the room through one door and can out through a different door ?

Solution : Clearly, a person can enter the room through any one of the five doors . So, there are five ways of entering the room . After entering into the room , the man can come out through any one of the remaining four doors. So, he can come out through a different door in four ways. Hence, the number of ways in which a man can enter a room through one door and come out through a different door = $5 \times 4 = 20$.

Question 4: A college has 6 gates . In how many ways can a student enter the college through one gate and can come out through a different gate ?

Solution : Clearly, a student can enter the college through any one of the six gates . So, there are six ways of entering the college . After entering into the college, the student can come out through any one of the remaining five gates. So, he can come out through different gates in five ways. Hence, the number of ways in which the student can enter a college through one gate and come out through a different gate = $6 \times 5 = 30$.

Question 5: Given 5 flags of different colours , how many different signals can be generated , if a signal requires that use of 2 flags one below the other?

Solution: In a signal there are two flags of different colours, so the first flag can be set by 5 ways and the second flag can be set by 4 ways. So different signals can be generated by $5 \times 4 = 20$ ways.

Question 6: The flag of a newly formed flag is in the form of three horizontal blocks, each to be coloured differently. If there are nine different colours on the whole to choose from, how many such designs are possible?

Solution: There are three blocks in the flag and there are nine colour options so there are nine options to fill the first block and eight options to fill the second block and seven options to fill the third block. Thus total number of possible designs are $9 \times 8 \times 7 = 504$ (because all three block will be filled by different colour)



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